A Review Paper on Design of Rubber Transfer Die

Kaustubh.J.Puranik[1], Dheeraj.P.Belhekar[2], Vaibhav.P.Agarwal[3], Abhishek.S.Chandane[4]
[1,2,3,4] *Zeal Institute of Engineering and Research Narhe, Pune*

Abstract- **In this paper, our main emphasis is on providing various aspects which are required in the design of die. Design and development of transfer die is one of the important phase in rubber technology. Basic terminologies considered in die design such as shore hardness, shrinkage allowance, curing time, tensile strength, etc. This paper also includes actual drawings of rubber transfer die with design procedure.**

I. INTRODUCTION

Rubber transfer molding is a process in which material is forced into a mold. Transfer molding process combines the principle of compression and transfer of the polymer charge. In the transfer molding, polymer charge is transferred from the transfer pot to the mold. The mold is cooled and molded part is ejected.

In this process, the required amount of NBR polymer is weighted and then it is inserted into the transfer pot before the molding process. The transfer pot is heated by the heating element above the melting temperature of the NBR polymer. The semi solid polymer is filled through the sprue to the mold cavity. The punch is used to push the semi solid polymer from the transfer pot into the mold cavity under pressure. The mold cavity remains closed as the polymer is inserted. The mold cavity is held closed until the polymer gets cured. The mold cavity is then opened and once it has been hardened.

II. THEORY

Process Parameters

- Heating time
- Melting temperature of the polymer
- Applied pressure
- Cooling time
- Shore hardness
- Shrinkage allowance
- Curing time
- Tensile strength

The basic terminologies used in transfer molding are:

Heating time:
It is the time required to change the temperature of the thermistor from an initial temperature to the final temperature.

Melting temperature of the polymer:
Melting temperature of the polymer is not a solid-liquid phase transition, but a transition from a crystalline phase to a solid amorphous phase. Here, crystalline melting phase is in context with thermoplastics, as thermosets will decompose at high temperatures rather than melting.

Applied pressure:
Pressure is the force applied perpendicular to the surface of an object per unit area over which that force is distributed.

Cooling time:
When the semi solid rubber has been transferred into the cavity it takes time to cool the semi solid rubber. After that the part can be removed from die. This heat transfer phenomenon of cooling of semi solid rubber is called as cooling time.

Shore hardness:
The resistance of a material to permanent indentation is called as shore hardness. There are different Shore Hardness scales for measuring the solidity of materials with different properties.

Shrinkage allowance:
Shrinkage is the reduction in volume during the cooling of molded polymer. Most of the rubber materials have the tendency to shrink during cooling. The rate of shrinkage with temperature is solely dependent on the material. Contraction of a rubber material is a volume effect.

Curing time:

Curing time refers to time taken by the polymer to toughen or harden with the help of chemical additives and heat. It can also be defined as the length of time to reach optimum viscosity at a certain temperature.

Tensile strength:
The resistance of a material to breaking under tension is called as tensile strength. The tensile strength of a rubber is emblematically expressed as the amount of force in MPa.

Materials used:
The material that we have used for die is Mild Steel. The polymer (insert) used for filling the cavity is Nitrile Butadiene Rubber (NBR).

III. NOMENCLATURE OF DIE

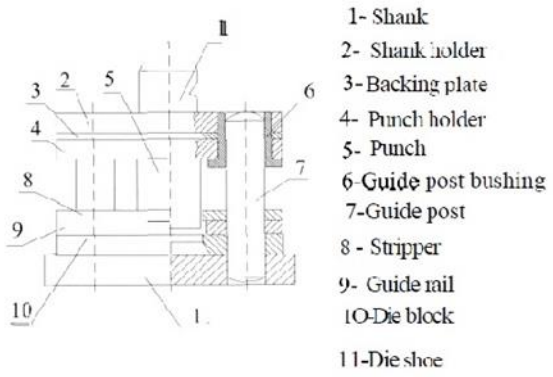


Fig.1.Die with guide post and guide post bushing.

1. Shank:
A shank is a part with the shape similar to that of pillar, and it is used to install the top die of a relatively small die in the slide of the press machine.
2. Shank Holder:
The shank holder is installed in the slide of the press machine, and the shank head is installed in the die.
3. Backing Plate:
When a large amount of force acts on a relatively smaller portion of area as in case of a hole opening punch, the punch holder gets dent as the punch is pressed.
4. Punch Holder:
The top plate is held with the help of a punch holder. It also serves the purpose for supporting the rigidity of top plate.
5. Punch:
Punch is a male part of the die which is responsible to cut, transfer or compress the material (charger or insert). The punch often passes through the work into a die.
6. Guide Post Bushing:
It provides an interface between two parts, damping the energy transmitted through it.
7. Guide Post:
Guide post is used to better align the punch holder with the die shoe. The guide posts have a slip fit with the guide bushing which are press fitted into the punch holder.
8. Stripper:
A plate used to strip the workpiece or part from the punch. The stripper is clamped and located directly on the block.
9. Guide Rail:
Guide rails are used to guide the work strip through the die, they are placed between the stock shelf or die block and the stripper plate or guide plate.
10. Die Block:
A die block is a construction component that houses the opening and receives punches. The die block is pre-drilled, tapped, and reamed, before being fastened to the die shoe.
11. Die Shoe:
A metal block inserted between the lower half of a cutting or shaping die and the bed of a press to spread the blow and avoid wear.

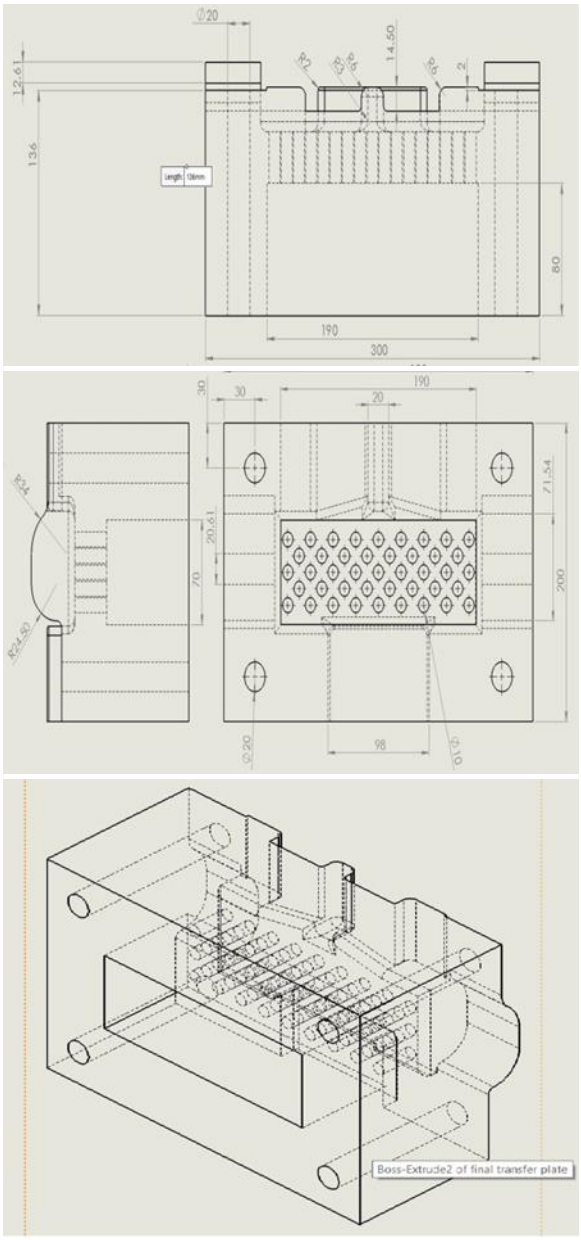
The basic design procedure for transfer die is as follows:

- Calculation of Die Clearance.
- Die Block
- Bottom Plate
- Punch
- Top Plate
- Guide Pillar

For selecting the suspension system the design procedure is as follow:

- Design and Improvement of several modules of the suspension
- Study dynamic aspect
- Adjust design constraints
- Statistical testing
- Dynamic testing
- Adjusting the design of component grounded on Dynamic Testing outcomes

IV. ACTUAL DRAWINGS OF DIE



V. CONCLUSION

In this paper, we have covered basic aspects of designing a transfer die. The die is specifically designed for defence purpose which is used for rubber molding of tracklink of armoured fighting vehicle BMP-1 trackchain.

REFERENCES

[1] Die Design Fundamentals, Second Edition, J.R.Paquin and R.E. Crowley. Industrial Press Inc.

[2] www.google.com/ wiki/Die_(manufacturing) terminology of Die Design.

[3] Handbook Of Die Design, Second Edition, Ivana Suchy, McGRAW-HILL HANDBOOKS.

[4] Sheet Metal Forming process And Die Design, Vukota Boljanovic, Industrial Press Inc. 200 Madison Avenue New York 10016.

[5] Cavity Fill Balancing Technique for Rubber Injection Molding, Van.T. Walworth and Terry Chapin, TechnoBtz USA Inc.

[6] Design and Analysis of Progressive Die for an Industrial Part, IJSR ISSN (Online): 2319-7064.

[7] Design and Analysis of Punching Die, IJRET eISSN: 2319-1163.